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User Emotion Based Selective Delivery Of Content

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ABSTRACT

User interaction with a server that provides online services such as social networking, media hosting and sharing websites, news, etc. is detected. The user interaction and other data such as user profile information is analyzed using machine-learning models trained to detect emotion. Available content items, such as user-provided content items and sponsored content items, are matched to the detected emotion based on various criteria to select and deliver particular content items to deliver to the requesting user. The described techniques for selection and delivery of content items based on detected emotion enable delivery of content items that have a high likelihood of providing a quality user experience and improve engagement of the user with the online service.

KEYWORDS

user emotion; emotion detection; user profile; user targeting; content delivery; content selection; machine learning; model selection; social network; media hosting; interaction data

BACKGROUND

Users access content via various online providers, e.g., social networking providers, media hosting and sharing websites, news websites, etc. Providers benefit from providing a positive user experience, e.g., by delivering content to each user that the user is likely to be interested in. Content can include content items that other users such as social network friends of a current user had viewed or otherwise interacted with. Content owners often provide criteria to provide individual content items to particular groups of users, e.g., based on user attributes. Accurately determining of content that a user finds interesting is important for providers and

content owners, because they benefit when a user views or interacts with the provided content or views sponsored content.
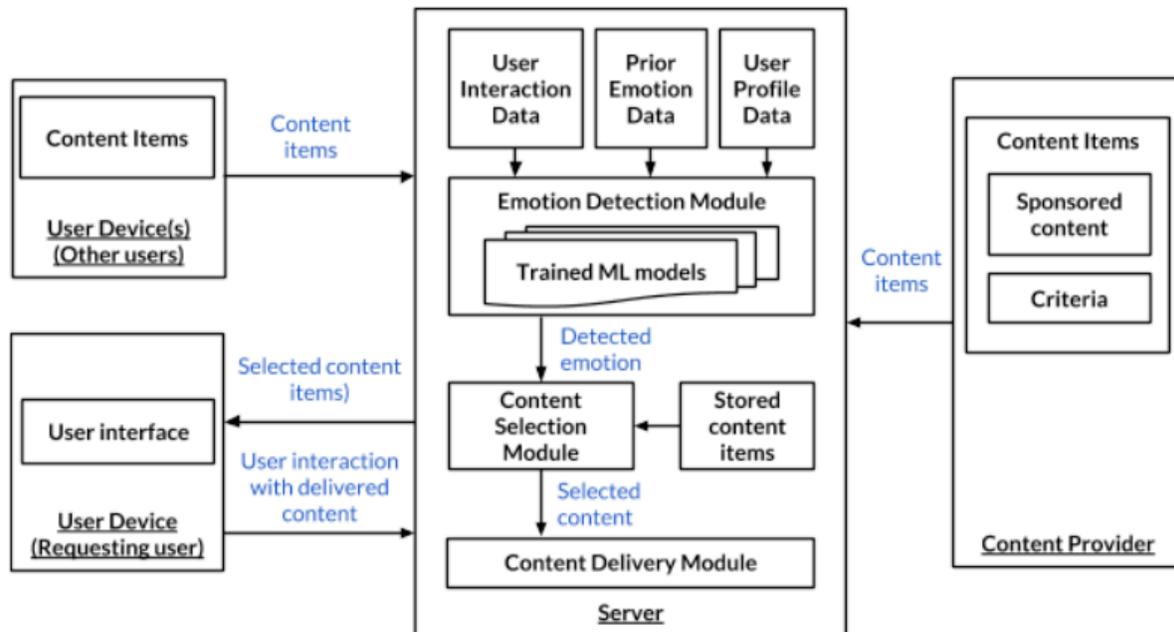
DESCRIPTION

Fig. 1: Delivering content based on user emotion and content-specific criteria

Fig. 1 is an illustration of an example environment for delivery of content items based on user emotion. Users access a server, e.g., a social networking provider, news website, media hosting website, etc., via a user device such as a computer, tablet, smartphone, wearable device, head mounted display, etc. In some instances, the access is two-way, users can receive content items from the server and also contribute content items such as images/videos, audio, text content such as documents, comments or online posts, etc. Users can also interact with the server by reacting to content items, e.g., as text comments or other feedback indicative of user emotions (e.g., via use emojis, selections of icons that allows user to react to content, etc.)

Fig. 1 illustrates a user device associated with a requesting user that is requesting content items from the server and displays them on a user interface, and other user devices associated with other users, e.g., that contribute content items to the server. User interactions of the user device that consumes content with the server are stored by the server as user interaction data. While different user devices are shown in Fig. 1 as submitting content to the server and interacting with the server, the same user device can submit content to the server and receive content from the server.

Content items can also be provided by content providers such as commercial content providers, audio or video producers, news outlets, blogs, online advertisers etc. Some content items, e.g., advertisements, sponsored posts, etc. may be deemed sponsored content. Content providers can pay for delivery of such content by the server to various user devices. Content items from such providers can also be associated with criteria that specify the users to which the content items are to be delivered, e.g., user demographics, interests, etc. and other contextual factors for delivery of content.

The server receives and stores content items ("stored content items") from user devices and content providers, and can also fetch content items from providers as needed. The server also stores user interaction data, prior emotion data, and user profile data. The server includes an emotion detection module that includes machine-learning models that are trained to detect user emotion based on the user interaction data, prior emotion data, and user profile data.

The emotion detection module provides a detected emotion to a content selection module that accesses stored content items or retrieves content items and associated criteria from content providers. The content selection module matches the detected emotion with the associated

criteria and selects content items for delivery to the user device of the requesting user. The content delivery module delivers the selected content items to user devices.

- **User interaction data:** User interaction data includes various factors such as the user accessing content items from the server or providing content items to the server. For example, user actions such as accessing certain content, reacting to content, e.g., by providing comments, or selecting a user interface element associated with a reaction; sharing the content with other users; etc. are included in the user interaction data. In some instances, e.g., if the server includes interaction information about other users that are associated with the current user such as followers, friends, contacts, etc., user interaction data also includes such information of these other users. Certain users such as celebrities or users that broadcast content to the requesting user are excluded from the other users.

- **Prior emotion data:** The server stores the detected emotion output by the emotion detection module as prior emotion data. Prior emotion data can be stored for a limited period of time. The period of time for which prior emotion data is stored may vary based on the detected emotion.

- **User profile data:** User profile data includes user attributes such as user demographics such as age, gender, location, etc. and other factors such as connections of the user to other users of the server, etc.

The server is configured to provide content items to a requesting user, e.g., in response to various user actions such as viewing particular content, refreshing a website provided by the server, interacting with content, etc. Delivery of content includes two stages - in a first stage, the server detects the emotion of the requesting user, and in the second stage, the server determines content items to provide to the requesting user based on the detected emotion.

1. *Detection of emotion of the requesting user*

The server analyzes the user interaction data to extract features associated with a requesting user to which content items are to be provided. For example, analysis of user interaction data to determine emotion can be performed at periodic intervals, upon each user interaction with the server, upon specific types of user interaction, etc. User interaction data is analyzed and updated as the user continues interacting with the server. The extracted features are updated as more interaction data is obtained as the user interacts with the server. Features extracted from the user interaction data can include changes in the rate of interaction between the requesting user and the server.

The server can include multiple ML models that have been trained for different groups of users, e.g., based on user demographics. For example, user demographics are determined based on user profile data. The emotion detection module selects an appropriate ML model or models, e.g., a model that matches the current user's demographics. For example, such a model is trained based on training data from users that have similar characteristics to the requesting user. The ML models can be implemented using any suitable machine-learning technique such as neural networks, Bayesian techniques, support vector machines, etc.

Training of machine-learning models: The ML models are trained based on training data stored by the server. Training data includes user-specific data such as user profile and detected emotions. Training data also includes user interaction data corresponding to different users. User interaction data can include user feedback provided on content items previously provided to the user and features of the content item. The model is trained to predict emotions based on the input data - the prediction generated by the model is matched with the detected emotions data. For

example, positive feedback is provided to the model when there is a match and negative feedback is provided otherwise, when the model is trained using reinforcement learning.

The emotion detection module executes the selected ML model(s) to determine the emotion state of the requesting user. The model takes as input features extracted from the user interaction data and prior emotion data to detect an emotion of the user. The features can be weighted, e.g., interaction events that are associated with low user burden, e.g., clicking an interface element, can be assigned a lower weight compared to interaction events that are associated with a higher interaction burden, e.g., typing a comment. Prior emotion data includes emotion detected at a prior run (or multiple prior runs) of the ML model. Prior emotion data can be assigned different weights. Further, prior emotion data can be provided as input in specific cases, e.g., if the requesting user changed to the prior detected emotion within a particular amount of time before the current user interaction event that led to the request for content.

The detected emotion can be represented in a variety of ways. For example, the detected emotion can correspond to a single emotional state such as "happy," "bored," "sad," "angry," "neutral," etc. The detected emotion is associated with a highest probability score that the requesting user is experiencing that emotion. Alternatively, the detected emotion can correspond to multiple emotional states, each associated with a corresponding score (e.g., "sad: 80%," "angry: 60%," "happy, bored: 10%") etc. where the score indicates a probability that the requesting user is experiencing that emotion. Alternatively, the score can indicate a strength of the particular emotion. The detected emotion output by the emotion detection module is based on a threshold score.

Detection of emotion based on user interaction data can be based on user interaction with content items of certain types. User interaction data can also include factors that explicitly

indicate the user emotion, e.g., selection of particular user interface elements associated with a particular emotion (e.g., a sad-face emoji). Explicit indication of the user emotion may override other factors evaluated by the emotion detection module.

The detection of emotion can also be based on detected emotions of other users that responded to content provided by the requesting user. For example, if the requesting user provided a photo, and other users respond with comments such as "lovely photo," "seems like a great vacation," etc., the detected emotion may be "relaxed" or "at ease." Detection of emotion is also based on content items that the requesting user interacted with recently, e.g., a video that the requesting user liked. Detection of emotion can also be based on detected emotions of other users that recently interacted with the requesting user.

Detecting emotion can be based on content provided by the user to the server. The server can store a mapping between keywords (or other content such as emojis) and emotions corresponding to the keywords. The keywords can be stored in a dictionary. The mapping can be generated based on determining that a frequency of users that provided the keywords in prior user interactions associated with a particular emotion meets a threshold frequency. The mapping is provided as input to the emotion detection module.

When user-provided content includes the keywords, the server determines emotion based on the mapping. For example, a phrase such as "I loved your photos, thanks for sharing!!!" is detected as including keywords such as "loved" and the phrase "!!!" which may be mapped to a "happy" emotion. In another example, users that provide an emoji such as a smiley face - " ☺ " - or select a corresponding user interface element such as a thumbs-up or love button, can also be detected as having a "happy" emotion. Multiple mappings are stored for different languages and

keywords from user-provided content are matched with the mapping of the language of the user-provided content.

The detection of emotion is repeated periodically, since the emotion of a requesting user can change over time. The trained ML models are set up to evaluate user interaction data for different users differently such that similar user interactions can result in different detected emotions and associated scores for different users.

2. *Selection of content items and delivery to the requesting user*

The content selection module identifies content items that can be provided to the user. Content items can also be associated with particular emotions, e.g., a content item that evokes happiness in users that view the content item (e.g., a funny video clip) from users can be associated with a "happy" emotion. The particular emotion associated with a content item can be determined by reviewers that view the content item, or be derived based on changes in the emotion of users that viewed the content item. For example, if a number of users change from a "bored" to "happy" state, the content item is associated with a "happy" emotion.

The content selection module makes a decision of whether to send particular content items of the identified content items based on the detected emotion. For example, if the criteria for a particular identified content item specify that the content item is to be delivered to users that have a particular emotion, the content selection module provides such items only if the detected emotion matches the criteria. In another scenario, the content selection module omits content items if the detected emotion matches an emotion that the criteria indicates for excluding from delivery of the content items. The criteria can also specify threshold scores associated with the detected emotion for corresponding content to be provided to the requesting user.

In some examples, the criteria associated with content items can also specify a target emotion for the requesting user. The content selection module determines whether presenting a particular content item is likely to establish the target emotion for the requesting user. The content selection module withholds certain content items if the likelihood of the user switching to the target emotion is low and provides content items that have a high likelihood of establishing the target emotion. For example, if the detected emotion for a requesting user is "bored," and the target emotion is "happy," the server delivers a content item such as a funny picture of a friend, rather than a content item associated with a neutral target emotion, such as a news article.

The content selection module can also withhold content items from being provided to the user for a particular period of time. For example, different detected emotions can have different periods of time for which the emotion lasts (e.g., "excited" may be shorter than "neutral" or "happy"). The period of time is also based on the score associated with the detected emotion. The particular period of time is dependent on the detected emotion and may be greater than the period of time for which the emotion lasts. The content delivery module delivers content items to a requesting user while the user is in the particular emotional state that matches the criteria.

CONCLUSION

User interaction with a server that provides online services such as social networking, media hosting and sharing websites, news, etc. is detected. The user interaction and other data such as user profile information is analyzed, using trained machine-learning models, to detect emotion. Available content items, such as user-provided content items and sponsored content items, are matched to the detected emotion based on various criteria to select and deliver particular content items for delivery to the requesting user. The described techniques for selection and delivery of content items based on detected emotion enable delivery of content

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